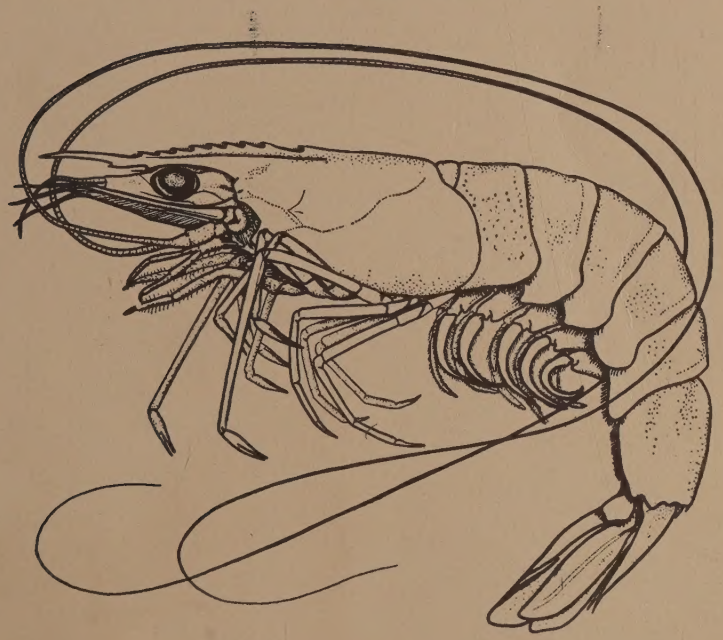
S.F.W.S. Fishery Leaflet
589
#58

THE SHRIMP AND THE SHRIMP FISHERY OF THE SOUTHERN UNITED STATES

LIBRARY
AUG 1 1966
FISH & WILDLIFE SERVICE



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES

Fishery Leaflet 589

THE SHRIMP AND THE SHRIMP FISHERY OF THE SOUTHERN UNITED STATES

By

WILLIAM W. ANDERSON

Fishery Biologist (Research)
Bureau of Commercial Fisheries Biological Laboratory
Brunswick, Georgia

The shrimp fishery of the United States is centered primarily in the eight South Atlantic and Gulf States (North Carolina to Texas), where about 216 million pounds of heads-on shrimp valued at about $69 million to the fishermen were taken in 1963. It ranks first in value of all the fisheries of the United States.

Figure 1.--Gulf of Mexico medium sized shrimp trawler.

Three species of shrimp, all members of one family (Penaeidae), are of the greatest commercial importance. Separation of the catch by species in recent years indicates that the common or white shrimp (Penaeus setiferus) is no longer the dominant species in the catches; in 1963 it contributed about 36 percent of the catch in the Gulf of Mexico and about 48 percent along the South Atlantic, whereas the brown shrimp (Penaeus aztecus) comprised about 44 percent of the catch in the Gulf and about 48 percent along the South Atlantic. The pink or brown-spotted shrimp (Penaeus duorarum) yielded about 19 percent of the Gulf catch (largely in the Tortugas area) and 4 percent of the South Atlantic production (largely in North Carolina).

Two other shrimps are of minor importance. The sea bob (Xiphopeneus kroyeri), is taken mainly in Louisiana and comprises only about 1 percent of the catch. Exploratory fishing by the U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, has indicated commercial concentrations of another species, the royal red shrimp (Hymenopenaeus robustus), in deep waters off the Continental Shelf in the Gulf and South Atlantic regions. These royal red shrimp occur from about 175 to 300 fathoms and have not as yet been fished extensively, although a few vessels are working the grounds to a limited extent.

Figure 2.--Catch of royal red shrimp from about 175 fathoms off east coast of Florida, on deck of Bureau's M/V Silver Bay. (Photo by Exploratory Fishing and Gear Research Station, Brunswick, Ga.)

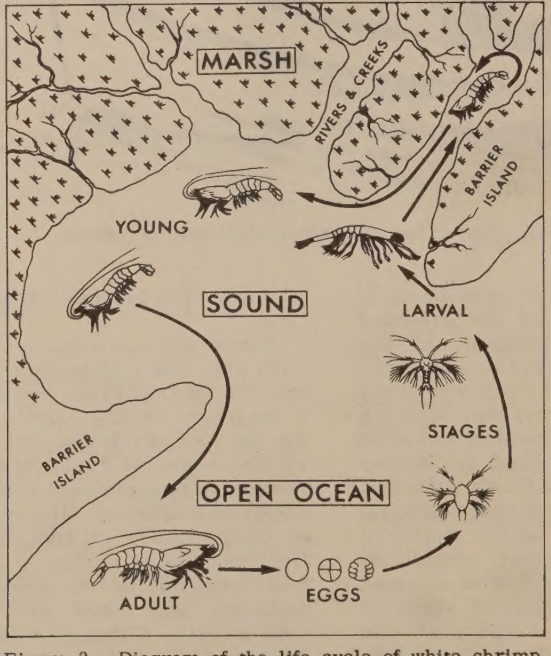


Figure 3.--Diagram of the life cycle of white shrimp (after Anderson and Lunz 1965).

In the sea bob the last two pairs of walking legs are slender and much elongated. It was from these four elongate legs and the antennae or feelers that the name "sea bob" apparently was derived. Sea bob is a corruption of the French "six barbes" or six beards, the name given to this shrimp by the Louisiana fishermen of French descent. The sea bob does not attain nearly the size of the other commercial species.

All of these species of shrimp have the first three pairs of thoracic or walking legs (of which there are five pairs in all) ending with chelae or pincers, but can be distinguished by various differences. The white, brown, and pink shrimp have teeth both above and below on the rostrum or head spine, whereas the sea bob and royal red shrimp have teeth only on the upper surface. The brown and pink shrimp can be distinguished from the white by the presence of grooves on either side of the rostrum which extend to the back margin of the carapace or head shell; in the white shrimp these grooves do not extend more than half the length of the carapace. The brown and pink shrimp are not so readily separated; the best field character is the width of the grooves along each side of the top ridge on the sixth tail segment--in the brown shrimp this is wide open (permitting entry of a fingernail in fair-sized specimens), whereas in the pink shrimp it is almost closed.

The males can be distinguished from the females by the presence of a structure called the petasma, which appears as a projection on the inner side of the first pair of swimming legs (underneath first tail segment).

We know more about the white shrimp than any of the others. A brief outline of its life history is given here as an example of penaeid shrimp development.

LIFE HISTORY OF THE COMMON OR WHITE SHRIMP

Habitat

The white shrimp is most abundant in areas that are characterized by an inland, brackish marsh connected by passes with an adjacent shallow, offshore area of relatively high salinity and mud or clay bottom. The offshore characteristics seem to be required by adults and perhaps also by the larvae, and the inland marshes appear to be required by the postlarval preadult. The adults are rarely found in abundance in the Gulf of Mexico in depths greater than 30 fathoms; along the South Atlantic coast the distribution appears limited to a narrow coastal belt not more than 8 to 10 miles off the coast (less than 10 fathoms). The preadults inhabit brackish water and at times are found in water that is almost fresh.

Spawning

The white shrimp, unlike the crab and crayfish, does not carry the eggs attached to appendages on the ventral surface of the abdomen but lays them directly into the water. The eggs issue from the bases of the third walking legs of the female and are apparently fertilized on emission by sperm contained in a capsule called a spermatophore. This capsule is transferred to the female by the and, apparently with the aid of the petasma, attached between the last several pairs of walking legs. A female produces from 500,000 to 1,000,000 eggs in a single spawning, and it is probable that some females at least spawn more than once. Most, if not all, spawning takes place at sea and not in the estuarine inland waters, and occurs mainly from late March or early April to the end of September.

Eggs and larvae

The eggs are spherical, about 1/75 of an inch in diameter, and sink to the bottom. The larval development apparently covers at least 10 distinct stages excluding the egg. These consist of five nauplair, three protozoeal, and two mysis stages (technical terms for stages of growth).

The larval development of the white shrimp requires from 2 to 3 weeks. Some 20 to 24 hours after the egg is spawned the young shrimp, called nauplius and resembling a tiny mite, breaks the egg membrane and emerges. This minute organism (about 1/75 of an inch long) is to a great extent at the mercy of the prevailing currents. During the next 24 to 36 hours the nauplius undergoes five successive molts to become a protozoea about 1/25 of an inch long. It now has seven pairs of appendages, a pair of compound eyes, and a complete alimentary tract. Prior to this stage the food of the nauplius has been the yolk material carried over from the egg. This food supply is now exhausted, and henceforth the protozoea must capture its own food to survive. This transitional period is without doubt a critical one. After several more molts and stages the organism ends its larval phase and assumes the general proportions of a miniature adult. At the end of two postlarval stages and 15 to 20 days after hatching, the

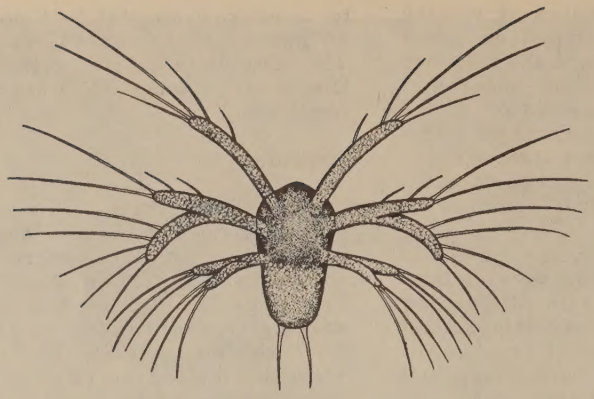


Figure 4.--Larval white shrimp shortly after hatching; first nauplius, about 1/85-inch long (after Pearson 1939).

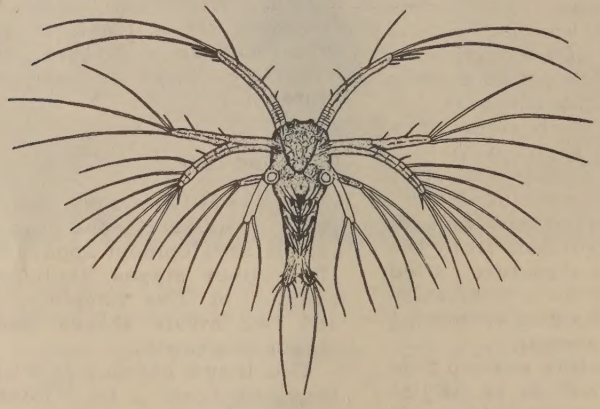


Figure 5.--Larval white shrimp about 1 day after hatching; fifth nauplius, about 1/45-inch long (after Pearson 1939).

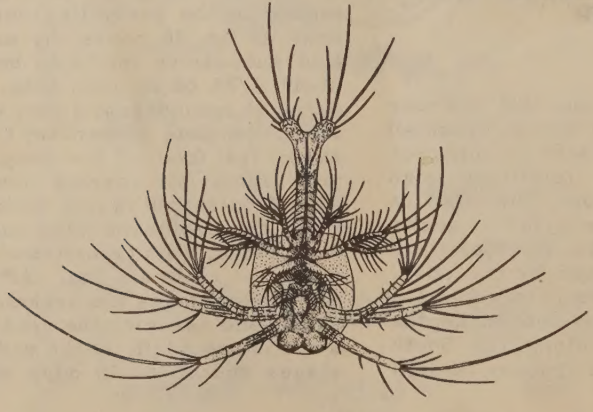


Figure 6.--Larval white shrimp about one to 1 1/2 days after hatching and fifth naupliar molt; first protozoea, about 1/28-inch long (after Pearson 1939).

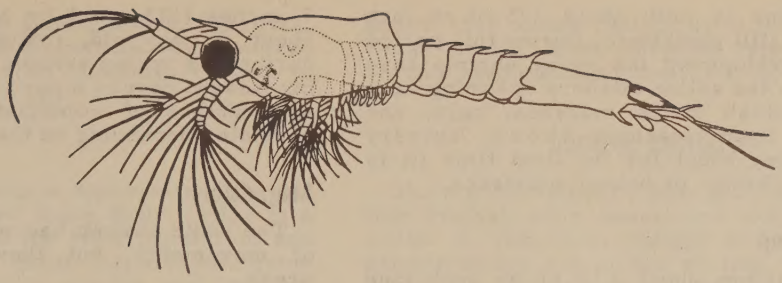


Figure 7.--Larval white shrimp; third protozoea, about 1/10-inch long (after Pearson 1939).

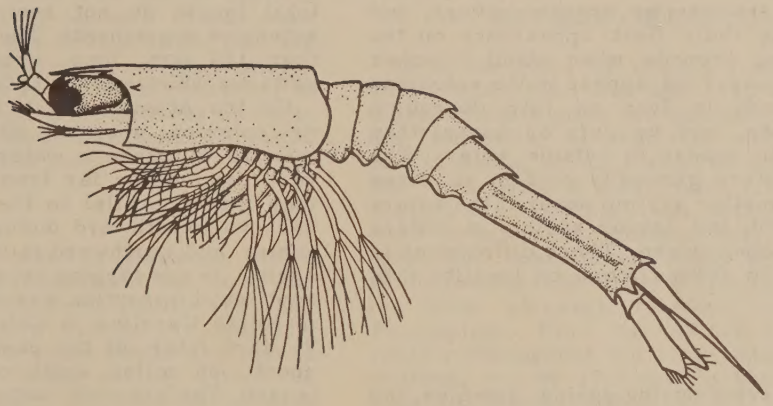


Figure 8.--Larval white shrimp; first mysis, about 1/8-inch long (after Pearson 1939).

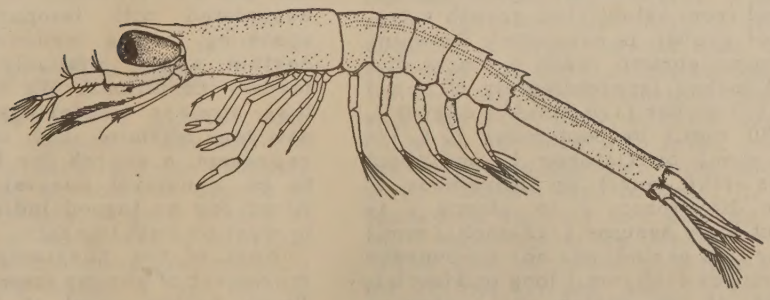


Figure 9.--Larval white shrimp about 15 to 20 days after hatching; second postlarva, about 1/5-inch long (after Pearson 1939).

young shrimp is only about 1/5 of an inch long and is still planktonic. During this period of early development the young shrimp have moved from the saline offshore spawning area to the brackish inside marshes, bays, and estuaries. Upon reaching these "nursery grounds" they adopt for the first time (it is believed) a benthic or bottom existence.

Young shrimp

Young shrimp about 1/3 of an inch long are found during the spring and summer in the brackish inside areas which serve as their nursery grounds. This habitat is a rich feeding ground characterized by shallow water, muddy bottoms, rather widely fluctuating seasonal temperatures, and moderate to low salinity.

As the young grow, they move from the shallow waters of the marsh, bayou, and lagoon into the deeper creeks, rivers, and bays, making their first appearance on the inside fishing grounds when about 2 inches long. The young first appear in the estuarine fishing grounds in June or July, depending upon the area, and by July or August they have begun to appear in outside waters. The estuarine waters generally contain all sizes of shrimp; smaller shrimp occur in the waters farther inland and larger shrimp in waters nearest the open ocean. These differences in size appear to depend more on locality than salinity.

Growth

Growth is rapid during spring, summer, and early fall, and negligible in the winter. The periods of rapid and slow growth appear to be associated with temperature; if so, we could expect growth to vary somewhat from year to year and with locality. A general statement of growth is further complicated by the fact that shrimp of different sizes grow at different rates. We believe that shrimp reach a little over 3 inches (80 mm.) in length (from tip of rostrum to the end of telson) about 2 months after spawning. On this basis and from established growth rates, an example of growth is presented: Spawning on May 1; young shrimp reach a length of a little over 3 inches (approximately 80 mm.) by July 1, 4-1/3 inches (110 mm.) by August 1, 5 inches (130 mm.) by September 1, 5-3/4 inches (145 mm.) by October 1, and about 6-1/5 inches (158 mm.) by November 1; growth from November 1 to March 1 is negligible, but if we assume 1/12-inch (2 mm.) growth during this period, our shrimp average about 6-1/3 inches (160 mm.) long on March 1, the beginning of the spring rapid growing season; they reach a length of about 6-2/3 inches (168 mm.) by April 1 and almost 7 inches (173 mm.) by May 1; they are now about 1 year old, mature, and will spawn during this spring season. Because the spawning season covers a period of about 6 months, any number of combinations of growth are possible, depending on the month of spawning.

Migrations

The white shrimp has very definite patterns of movements, but they vary in different areas.

In one respect the movements are similar in all localities--after the young shrimp first make their appearance on the inland fishing grounds thay gradually work their way towards the sea. Once the shrimp have reached the outside waters their movements vary with the size of the shrimp, the locality, and apparently also the time of the year. Small shrimp 130 mm. (about 5 inches) or less in total length do not seem to undertake any extensive movements. The large shrimp, more than 130 mm. long, show distinct behavior patterns which vary with locality.

On the Atlantic coast, the bulk of the white or common shrimp, after migrating from inshore to offshore waters, do not move into very deep water far from the coast. Instead, they move parallel to the shoreline with the seasons--southward during the fall and early winter and northward in late winter and early spring. In our tagging experiments, the longest southward migration was by a shrimp released in North Carolina in October and recaptured 95 days later off the east coast of Florida--about 360 miles south of where it was released. The greatest northward migration was by a shrimp released in central Florida in January and recaptured 168 days later about 260 miles to the north, off the coast of South Carolina.

Along the Louisiana coast west of the Mississippi River the large shrimp move offshore and scatter during the fall and winter. At all times they seem to be drifting about, like cattle on open range land. The only definite patterns seem to be offshore and onshore movements, which evidently are associated with temperature changes and spawning, and a tendency to concentrate in certain areas, probably because of better feeding conditions. We believe the more or less aimless wanderings of the shrimp (but not the offshore and onshore movements) represent a search for food. There appears to be a natural barrier at the Mississippi River for no tagged individuals crossed east to west or west to east.

West of the Mississippi River a possible movement of shrimp from central and southern Texas to the coast of Mexico is indicated during the fall and early winter, probably comparable to the movement along the South

Atlantic coast of the United States. Likewise, there is evidence of a south-to-north migration in the spring from northern Mexico to Texas.

Longevity

Mortality of shrimp is apparently high, and the number that live more than 1 year is a small percentage of the total population and is probably not of great importance. Some shrimp live at least 16 months and possibly longer, but as far as the fishery is concerned the common or white shrimp can be considered an annual.

Food

The shrimp is omnivorous--it eats plant detritus, worms, crustaceans, and small mollusks. Mud and sand also can be found in its intestinal tract. In aquaria it has been observed to attack and devour small fish and other shrimp. A shrimp is particularly susceptible to attack from another member of the same species during the process of molting, when the old shell has been discarded and the new one is still soft.

Miscellaneous

The shrimp, like other crustaceans, wears its skeleton on the outside of the body and in order to grow must cast off this shell and replace it with a new and larger one. The frequency with which these shells are cast is not known, but with young shrimp during the season of rapid growth the interval between molts appears to be relatively short. In the process of shedding, all of the hard structures of the shrimp are cast off and renewed.

The white shrimp swims forward by the use of the pleopods or abdominal feet. When frightened or when rapid movement is required the shrimp, with a flip of the abdomen, can propel itself backward with remarkable speed. This flexing of the powerful muscular abdomen also enables the shrimp to leap clear of the water.

NUTRITIVE VALUE OF SHRIMP

Shrimp possess the same general food properties that are commonly attributed to fishery products. In general, marine products are an excellent and economical source of highly digestible proteins, a good source of vitamins, and an excellent source of minerals in quantity and variety. Shrimp are unusually rich in minerals and contain a high natural content of iodine. As a consequence, shrimp like other marine foods are ideal for those areas in which goiter is prevalent. It is well known that iodine deficiency in the diet is the cause of the most common type of goiter. Shrimp also contain vitamins A and D.

IODINE SHRIMP

Shrimp occasionally possess iodoform odor (the typical odor associated with hospitals) which is commonly thought to be caused by preservatives put on the shrimp. On the contrary this condition occurs because the shrimp has eaten various marine organisms which impart the odor. Croakers and other bottom-living fish frequently possess this same iodoform smell, which is undoubtedly caused by a source similar to that of the shrimp. Although possibly unpleasant, it is not harmful.

METHODS OF CAPTURE

Until the otter or shrimp trawl was introduced some time between 1912 and 1915, the most efficient gear for catching shrimp was the haul seine. At about that time, the Bureau of Fisheries, at its station in Beaufort, N.C., had been using a small otter trawl to collect marine forms. Fishermen, noting that shrimp were being taken by these nets, adopted the idea, and constructed larger trawls for use in the commercial shrimp fishery. Apparently, the first shrimp trawling took place at Fernandina, Fla. Use of the trawl spread rapidly throughout the south Atlantic and Gulf regions, and by 1917 trawls had become the standard commercial gear.

The haul seine fishery gradually disappeared after the trawl was developed and put in widespread use. Louisiana was the last locality in which the seine was employed. During the early 1930's, a few seines were still being used, but they dropped out one by one until at present none appears to be in operation, and the trawl remains as the exclusive gear for commercial operations.

Introduction of the trawl completely revolutionized the shrimp industry. Whereas the haul seine could be used only in shallow water, required a large crew of men, and could be operated for only a limited time during the summer and fall, the shrimp trawl was adaptable for use over a much greater range, could be operated with fewer men, yielded a greater production per man, and was a much more efficient type of gear. Its introduction opened up entirely new grounds and led to a rapid expansion of the fishery.

The size of trawls now in use varies from the 10-foot try net, used for locating schools of shrimp, to the vessel's main trawl which may have a spread of 120 feet at the mouth. Its dimensions depend largely on the size and

power of the vessel. A recent innovation is the use of two smaller trawls (about 40 feet), one on each side of the vessel, instead of one larger trawl.

Fishing for white shrimp is almost entirely during daytime, whereas trawling for the brown and pink shrimps is a nighttime operation.

The following publications contain further and more detailed information on the shrimp and shrimp fishery of the southern United States.

ANDERSON, WILLIAM W.
1956. January to April distribution of the common shrimp of the South Atlantic Continental Shelf. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 171, 14 p.

ANDERSON, WILLIAM W., JOSEPH E. KING, and MILTON J. LINDNER.
1949. Early stages in the life history of the common marine shrimp, Penaeus setiferus (Linnaeus). Biol. Bull. (Woods Hole) 96 (2): 168-172.

ANDERSON, WILLIAM W., and MILTON J. LINDNER.
1943. A provisional key to the shrimps of the family Penaeidae with especial reference to American forms. Trans. Amer. Fish. Soc. 73: 284-319.

ANDERSON, W. W., M. J. LINDNER, and J. E. KING.
1949. The shrimp fishery of the southern United States. Com. Fish. Rev. 11 (2), 17 p.

ANDERSON, WILLIAM W., and G. ROBERT LUNZ.
1965. Southern shrimp--a valuable regional resource. Atlantic States Marine Fish. Comm. Leaflet 4, 6 p.

BULLIS, HARVEY R., JR.
1957. Royal red shrimp--A new South Atlantic resource. Proc. Gulf Carib. Fish. Inst., 9th Annu. Sess.: 56-60.

IDYLL, CLARENCE P.
1950. A new fishery for grooved shrimp in southern Florida. Com. Fish. Rev. 12(3): 10-16.
1957. The commercial shrimp industry of Florida. Florida State Board Conserv., Educ. Ser. 6 (reissue), 30 p.

IVERSEN, E. S., and C. P. IDYLL.
1959. The Tortugas shrimp fishery: the fishing fleet and its method of operation. Florida State Board Conserv., Tech. Ser. 29, 35 p.

JOHNSON, FRED F., and MILTON J. LINDNER.
1934. Shrimp industry of the South Atlantic and Gulf states. U.S. Bur. Fish., Invest. Rep. 21, 83 p.

JOYCE, EDWIN A., JR.
1965. The commercial shrimps of the northeast coast of Florida. Florida State Board of Conserv., Prof. Pap. Ser. 6, 224 p.

KING, JOSEPH E.
1948. A study of the reproductive organs of the common marine shrimp, Penaeus setiferus (Linnaeus). Biol. Bull. (Woods Hole) 94 (3): 244-262.

KUTKUHN, JOSEPH H.
1962. Gulf of Mexico commercial shrimp populations--trends and characteristics, 1956-59. U.S. Fish Wildl. Serv., Fish. Bull. 62: 343-402.

LINDNER, MILTON J., and WILLIAM W. ANDERSON.
1956. Growth, migrations, spawning and size distributions of shrimp, Penaeus setiferus. U.S. Fish Wildl. Serv., Fish. Bull. 56: 553-645.

PEARSON, JOHN C.
1939. The early life histories of some American Penaeidae, chiefly the commercial shrimp, Penaeus setiferus (Linnaeus). Bull. U.S. Bur. Fish. 49: 1-73.

SPRINGER, STEWART.
1955. Exploitation of deep-water shrimp of the Gulf of Mexico. Proc. Gulf Carib. Fish. Inst., 7th Annu. Sess.: 67-71.

VOSS, GILBERT L.
1955. A key to the commercial and potentially commercial shrimp of the family Penaeidae of the western North Atlantic and the Gulf of Mexico. Florida State Board Conserv., Tech. Ser. 14, 23 p.

WEYMOUTH, F. W., MILTON J. LINDNER, and W. W. ANDERSON.
1933. Preliminary report on the life history of the common shrimp, Penaeus setiferus (Linnaeus). Bull. U.S. Bur. Fish. 48: 1-26.

WILLIAMS, AUSTIN B.
1965. Marine decapod crustaceans of the Carolinas. U.S. Fish Wildl. Serv., Fish. Bull. 65: 1-298.

MS. #1522

Revised January 1966

* U.S. GOVERNMENT PRINTING OFFICE : 1966 O—211-929

Created in 1849, the Department of the Interior--a department of conservation--is concerned with the management, conservation, and development of the Nation's water, fish, wildlife, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

As the Nation's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States--now and in the future.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES
WASHINGTON, D.C. 20240

OFFICIAL BUSINESS

Return this sheet to above address, if you do NOT wish to receive this material ☐, or if change of address is needed ☐ (indicate change).

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF THE INTERIOR